






“Dynamics of tax revenues in the budget of Ukraine and their forecast during the crisis period”

AUTHORS	Oleh Skorba  Tetyana Pasko  Viktoriia Babenko-Levada  Tetiana Tereshchenko 
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Viktoriia Babenko-Levada, Tetiana
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Oleh Skorba, Ph.D. in Economics,
Assistant Professor, Department of
Accounting and Taxation, Sumy State
University, Ukraine. (Corresponding
author)

Tetyana Pasko, Ph.D. in Economics,
Assistant Professor, Department of
Management, University of Business in
Wroclaw, Poland.

Viktoriia Babenko-Levada, Ph.D.
in Economics, Assistant Professor,
Department of Finance, Banking and
Insurance, Zaporizhzhia Polytechnic
National University, Ukraine.

Tetiana Tereshchenko, Ph.D. in
Economics, Associate Professor,
Department of Banking and Financial
Services, University of Customs and
Finance, Ukraine.



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Oleh Skorba (Ukraine), Tetyana Pasko (Poland), Viktoriia Babenko-Levada (Ukraine),
Tetiana Tereshchenko (Ukraine)

DYNAMICS OF TAX REVENUES IN THE BUDGET OF UKRAINE AND THEIR FORECAST DURING THE CRISIS PERIOD

Abstract

It is extremely important for the budget process to obtain accurate forecasts of potential tax revenues, especially in periods of disruption and crisis. The paper is devoted to the study of dynamics of tax revenues' volumes in the budget of Ukraine and the forecast of their values during the crisis.

The dynamics of tax revenues in the Consolidated Budget of Ukraine, studied by using randomized R|S-analysis, fractal and probabilistic analyses as well as entropy calculation based on the data on monthly tax revenues for the period 2011–2021, is anti-persistent, fractal-like and unpredictable based on parametric dependencies, simple and complex trends. The topological dimension of the lines of dynamics for tax revenues of all types of taxes is much higher than 1, and the Hirst index indicates either fractal similarity of dynamics or its chaos. The map of dissipation periods of tax revenues in Ukraine, determined on the basis of entropy calculation and periods of negative entropy production according to the dynamics of tax revenues, coincided with the periods of maximum reduction in their volumes. The most crisis periods in the formation of tax revenues are 2019–2020, for certain types of taxes – 2016–2020, but the dissipation of tax revenues is projected for 2021–2022.

The comparison of the level of fractal similarity in dynamics of the volume of tax revenues and peculiarities of the dynamics of entropy and entropy production, allowed to substantiate the division of taxes into nine types, of which five were found in Ukraine.

Keywords tax revenues, R|S-analysis, forecast, entropy, types of taxes, crisis, tax instruments

JEL Classification C10, C33, H12, H20

INTRODUCTION

The main source of financial resources of the state are tax revenues, the adequacy of which determines the ability of the state to perform its security functions, regulate economic development, and meet social needs of the population. The organization of financing of state expenditures presupposes, first of all, the existence of sufficient and adequate information on the amount of financial resources in future budget periods. The determination of general patterns in the dynamics of budget revenues is an important stage of the budget process in all countries.

The planning and forecasting of budget revenues in general as well as tax revenues (in general and in particular for each type of tax) are also carried out in Ukraine. However, the amount of projected tax revenues never coincides with the actual data. This necessitates constant adjustment of the state budget during its implementation. Obviously, such adjustments reduce the efficiency of the budget process and often lead to additional external borrowing or budget sequestration. The discrepancy between the projected and actual amount of tax revenues

occurs especially in times of crisis, as the intensity and depth of crisis processes are often higher than in any forecasts. In addition, external destructive influences lead to an increase in the budget of Ukraine to ensure its military and political security, which determines the need for the most accurate forecasting of tax revenues.

1. LITERATURE REVIEW

Determining the projected amount of tax revenues is an important scientific, methodological and practical task. It is no coincidence that obtaining such forecasts in Ukraine is regulated at the legislative level. For example, there is the “Methodology for forecasting value added tax revenues”, approved by the Orders of the Ministry of Finance of Ukraine (No. 545 as of August 31, 2004), the Ministry of Economy and European Integration of Ukraine (No. 315 as of August 31, 2004), The State Tax Administration of Ukraine (No. 502 as of August 31, 2004), the State Customs Service of Ukraine (No. 637 as of August 31, 2004), which is based on the index method of obtaining forecasts, based on the nominal and real tax rates, changes in benefits, dynamics and conditions of domestic demand, dynamics and conditions of gross value added, gross accumulation of equity, etc. There are also methods for forecasting excise tax revenues from excisable goods produced in Ukraine, revenues from personal income and corporate income taxes. The methodological principles of these techniques are very similar. As a rule, the definition of forecast tax revenues is based on narrow parametric dependencies and certain indices that illustrate the dynamics of the economy as a whole or its individual segments. As noted by Kozoriz (2018, p. 18), none of these methods gives the desired quality of the forecast of 3.5-5% (as recommended by the IMF), and in times of crisis there is a multiple exceeding of the permissible error limits.

At the state level, a wider range of methods for forecasting tax revenues is used, as noted by Vdovychenko et al. (2014, pp. 5-6). The most common of them include extrapolation, calculation of conditional elasticity, regression models, structural models, microsimulation models and their combinations. The greatest accuracy is given by a combination of different approaches and formation of composite models. For example, Reinmuth and Geurts (1979) proposed a model

that combines the results of forecasting tax revenues through a combination of the weight of different forecasts based on the building of regression values of the dependent variables from different forecasts. Madzivanyika (2016) uses regression modeling of the impact of customs duty incentives on their revenues, proving that reducing tax rates and applying other trade incentives reduce the fiscal efficiency of customs duties. Simple weather forecasts are quite common, especially in combination with expert methods (Beckett-Camarata, 2006). In general, at the state level forecasting of tax revenues is carried out using a wide range of methods, its accuracy is often low and depends on the organizational structure of forecasting and the frequency of institutional changes and changes in tax legislation (Vdovychenko et al., 2014, p. 17). Such errors became especially significant during the Covid-19 pandemic (IMF, 2020), which necessitated the expansion of conventional forecasting tools. Currently, forecast models based on historical data and expectations are considered less adequate. Methodical foundations of tax revenues' forecasting are in constant development. For example, it is proposed to specify models that are based on the elasticity in relation to the development peculiarities of each sector of the economy. At the same time, elasticity is used from other periods of recession, and not for the previous periods of cycles, which emphasizes the peculiarity of tax revenues' dynamics during crisis periods. Sabaj and Kahveci (2018, p. 10), when forecasting tax revenues to the Albanian budget, combine partial tax forecasts (arithmetic mean, median, truncated mean, geometric mean, harmonic mean, standard error; regression), determining the rank of each forecast and weighing them according to rank. Martynenko (2019) models the dependence of tax revenues on macroeconomic indicators, identifies trends and develops forecast scenarios of revenues to the budget of Ukraine from state taxes. Streimikiene et al. (2018) use different time series models to predict Pakistan's tax revenues, including autoregressive integrated sliding methods and a vector autoregression model using quarterly sta-

tistics. Similar models are cited by Molaro et al. (2019), forecasting the amount of tax revenues to the budget of South Africa and using monthly statistical data.

However, the error in forecasting tax revenues remains considerable if the same methods are applied to other objects. The magnitude of error in forecasting tax revenues may be due to the drawbacks of forecasting tools and uncertainty of environment or the process of tax collection.

Some researchers claim the existence of uncertainty in the processes of formation of tax revenues. The existence of variability in tax revenues is confirmed by Groves and Kahn (1952) (the first of the works on the volatility of tax revenues), Dye and McGuire (1991), Sobel and Holcombe (1996), Bruce et al. (2006), Giertz (2006), Seegert (2018). Seegert (2018), for example, noting the high level of uncertainty in tax revenues, considers two channels of its distribution: public and private consumption. In the United States, tax uncertainty has caused fluctuations in tax revenues of 40% from expected tax revenues. Accordingly, to develop an optimal tax policy, it is proposed the use of portfolio theory.

Therefore, the main methods of forecasting the amount of tax revenues and the impact of tax collection on economic development do not give stable repetitive results, regardless of the methods of measurement, the object of study and the subjective interpretation of researchers. There is also a significant variability of the object of study, more characteristic of chaotic processes, which is especially evident in times of crisis. The existence of signs of chaos is noted in other processes of public finance. For example, Zhuravka et al. (2021), studying the dynamics of public debt in Ukraine, confirmed a high level of fractal similarity (Hirst index is 0.74) and “long memory” of data series that was then used for further forecasting. Therefore, it makes sense to use some elements of the chaos theory in the study of dynamics of tax revenues and their forecasting.

The purpose of this paper is to determine the projected amount of tax revenues to the budget of Ukraine taking into account the patterns of their dynamics and the impact of crisis.

2. METHODOLOGY

Given the inefficiency of parametric models, simple and complex trend models in forecasting tax revenues, the sequence of the study was determined as follows (Figure 1):

- determining the adequacy of the use of probabilistic analysis in the formation of forecast on the amount of tax revenues. Usually, the amount of tax revenue is considered to be deterministic, depending on the production of gross domestic product. The dynamics of the latter depends on the stage of economic cycle. Some discrepancies between GDP production and strict cyclical patterns are explained, as a rule, by the existence of several types of economic cycles of different durations. The study proceeded from the indeterminist paradigm, according to which: all patterns are contingent; all processes are both deterministic and stochastic. According to Mandelbrot (1977), “all periodicities are “artifacts”, they do not characterize the process, but rather determine the total result, which depends on the process itself, the length of the sample and the judgments of the economist.” Therefore, at this stage, a randomized R|S analysis was used (Gachkov, 2009), the main advantages of which are the ability to determine fractal similarity and persistence of dynamics from inaccurate data, with the exception of strong random fluctuations. The results of randomized R|S-analysis not only meet the goals and objectives of the study, but also slightly expand them. In particular, one of the results is to obtain the fractal dimension of a series of dynamics (D), which for fractal-like dynamics should theoretically exceed the topological dimension;
- carrying out probabilistic analysis for the dynamics of tax revenues (for those data series for which such revenues are subject to probabilistic analysis) and the calculation of entropy (entropy production) for each individual moment (monthly) and for periods (average for the year). In turn, the definition of entropy production makes it possible to accept or reject the hypothesis of dissipation or process development. As Khaitun (2007) points out:

Source: Authors' compilation based on Gachkov (2009).

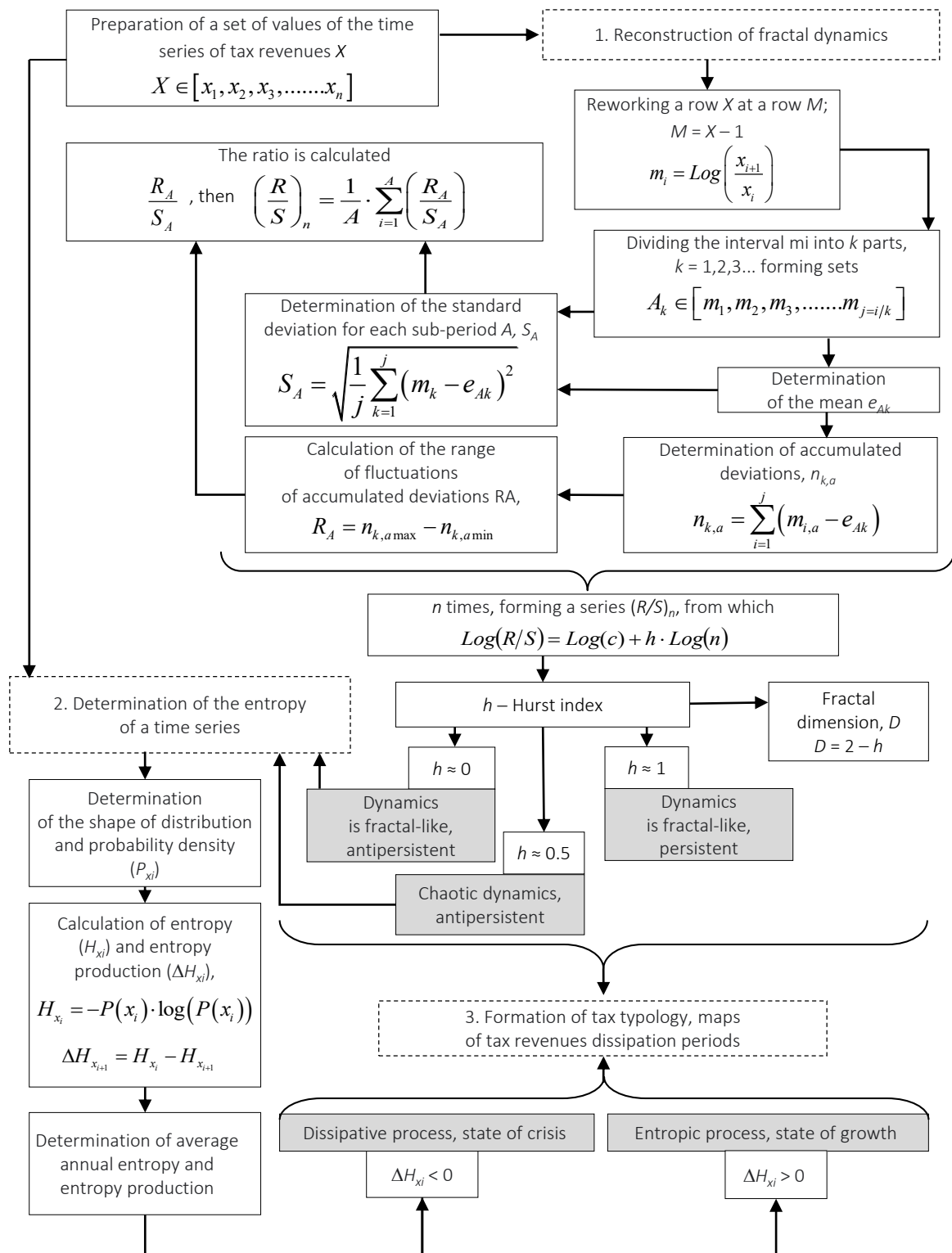


Figure 1. Sequence of forecasting the volume of tax revenues during the crisis

dissipation processes are characterized by negative entropy production, while processes with upward dynamics are positive. An additional result of the study may be the forecast

of tax revenues as the most probable value in accordance with the identified distribution law (or based on game theory, fuzzy modeling, etc.).

- generalization of the results of fractal and probabilistic analysis, with the formation of typology of taxes according to the peculiarities of their dynamics (fractality, stochasticity, persistence, etc.) and maps of periods of dissipation of tax revenues for different taxes.

This will make it possible to identify actual crisis periods in the functioning of the public finance subsystem and to identify the most general patterns in the dynamics of tax revenues by type of taxes. In particular, the assessment of entropy production will make more reasonable decisions on changes in the mechanism of tax collection.

The study used statistical data on the amount of tax revenues to the Consolidated Budget of Ukraine for the period January 2011–May 2021 in monthly terms according to the National Bank of Ukraine (NBU, 2020). Namely, the data included the amount of revenues: taxes and fees on income of physical persons; corporate income tax; rent and payments for the use of natural resources (including rent for the use of subsoil); excise tax on excisable goods (products) produced in Ukraine; excise tax on excisable goods imported into the customs territory of Ukraine; value added tax on goods produced in Ukraine (taking into account budget reimbursements); value added tax on goods imported into Ukraine; local taxes and fees (including the single tax); other taxes (including environmental tax and levies on the development of viticulture, horticulture and hop growing).

3. RESULTS

Results of R|S-analysis of the dynamics of tax revenues to the Consolidated Budget of Ukraine for the period January 2011–May 2021 are presented in Table 1.

According to the results, the dynamics of tax revenues is antipersistent (at least on a monthly basis) and fractal-like for the vast majority of taxes, the fractal dimension is much higher than 1. It is no coincidence that most forecasts of tax revenues have a significant error. The use of scenario approach makes it possible only to expand the range of forecast data and thus reduce the actual deviation from the forecast revenues. For local taxes and fees and the single tax, the Hearst index is close to 0.5, which corresponds to the dynamics of chaotic nature.

In general, according to the level of their fractality, all taxes can be divided into three groups:

- the dynamics of revenues volume is totally fractal-like, ($h < 0.3$; $h > 0.7$). This group includes taxes: corporate income tax, rent, rent for subsoil use, value added tax on goods produced in Ukraine, personal income tax, excise tax on excisable goods produced in Ukraine;
- the dynamics of revenues is close to fractal-like ($0.45 > h > 0.3$; $0.7 > h > 0.55$). It includes taxes: excise tax on excisable goods imported into

Table 1. Results of R|S-analysis of the dynamics of tax revenues to the Consolidated Budget of Ukraine for the period January 2011–May 2021

Source: Calculated by the authors.

By types of taxes	Hirst index, h	Topological dimension, D
Personal income tax and levy	0.2109	1.7891
Corporate income tax	0.1679	1.8321
Rent and payment for the use of other natural resources, of which:	0.2060	1.7940
Rent for subsoil use	0.1433	1.8567
Excise tax on excisable goods (products) produced in Ukraine, including a special tax on securities disposal transactions and derivative transactions	0.2109	1.7891
Excise tax on excisable goods (products) imported into the customs territory of Ukraine	0.2918	1.7082
Value added tax on goods (works, services) produced in Ukraine, taking into account the budget reimbursement	0.2069	1.7931
Value added tax on goods imported into the territory of Ukraine	0.3125	1.6875
Local taxes and fees, of which:	0.5508	1.4492
United tax	0.5076	1.4924
Other taxes and fees, including:	0.3390	1.6610
Environmental tax	0.2925	1.7075
Fee for the development of viticulture, horticulture and hop growing	0.3890	1.6110

the customs territory of Ukraine, value added tax on goods imported into Ukraine, other taxes and fees, environmental tax, fees for the development of viticulture, horticulture and hop growing;

- the dynamics of revenues is chaotic ($0.55 > h > 0.45$) – for local taxes and fees, a single tax.

Usually, the dynamics of the volume of tax revenues is defined as regular and cyclical, their volume is projected on the basis of either the usual trends of different forms, or parametrically – for annual data. Therefore, the obtained result can be determined by the effect of scale. Then it is necessary to state that on a large scale the dynamics of the volume of tax revenues is natural, on a smaller scale – fractal-like. In conditions of high uncertainty of economic processes, it is proposed to use high-frequency data (IMF, 2020), which will automatically change the type of dynamics from regular to fractal-like. Unfortunately, statistical data on the amount of tax revenues are not collected with a frequency greater than a month, so it is not possible to verify the transformation of the patterns of dynamics with increasing frequency and the existence of economies of scale.

Since none of the taxes showed the persistence of dynamics, it was advisable to conduct probabilistic analysis. The normality of probability distribution for revenues for all types of taxes with a slight asymmetry for some of them was confirmed and the entropy was calculated. The basis for determining the entropy was the natural logarithm for the probability density according to normal distribution. Table 2 shows a map for the periods of dissipation of revenues by types of taxes in the Consolidated Budget of Ukraine in the period 2011–2020 based on the results of assessment of entropy production. In 2021, entropy production was not estimated due to insufficient data.

Negative entropy production was observed mainly at the end of the period 2011–2020. For entropy production in the formation of tax revenues taxes can also be divided into three groups:

1. The deepening of dissipation in the processes of tax revenues formation. This group includes: corporate income tax, rent, rent for

subsoil use, value added tax on goods produced in Ukraine, excise tax on excisable goods imported into the customs territory of Ukraine, value added tax on goods imported into Ukraine. These taxes primarily apply to the real sector of the economy, production processes, exports and imports. The payers of such taxes are mostly companies, although physical persons can also be in this group. The formation of tax revenues from these taxes is characterized not just by negative entropy production, but its increase, which illustrates the deepening of crisis processes in the real sector;

2. The decrease of dissipation in the processes of tax revenues' formation. This group includes personal income tax, excise tax on excisable goods produced in Ukraine. These are mostly consumption taxes. In this case the dissipation in the formation of revenues is the longest (from 2016 to 2020), but has a clear tendency to decrease. Therefore, it can be argued that there is a decrease in crisis processes in the field of consumption and one can expect an increase in revenues for this group of taxes. This seems natural, as consumption taxes are considered more stable in revenue generation than income or income taxes (IMF, 2020);
3. The random nature of dissipation in the processes of formation of tax revenues: other taxes and fees, environmental tax, fees for the development of viticulture, horticulture and hop growing, local taxes and fees, single tax. For this group of taxes, negative entropy production is observed once or twice during the period 2011–2020. It has no definite dynamics and cannot characterize certain crisis phenomena as systematic. Local taxes and the single tax in general are characterized by chaotic dynamics, so all the crisis phenomena behind them are likely to be random.

Trends in entropy production by certain types of taxes make it possible to predict a gradual cessation of dissipation by the end of 2022 for taxes and fees on personal income and excise tax on goods produced in Ukraine. A significant deepening of dissipation is expected from corporate

Table 2. Periods of dissipation of tax revenues to the Consolidated Budget of Ukraine by different types of taxes

Source: Calculated by the authors.

By types of taxes	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Personal income tax and levy										
Corporate income tax										
Rent and payment for the use of other natural resources, of which:										
Rent for subsoil use										
Excise tax on excisable goods (products) produced in Ukraine, including a special tax on securities disposal transactions and derivative transactions										
Excise tax on excisable goods (products) imported into the customs territory of Ukraine										
Value added tax on goods (works, services) produced in Ukraine, taking into account the budget reimbursement										
Value added tax on goods imported into the territory of Ukraine										
Local taxes and fees, of which:										
United tax										
Other taxes and fees, including:										
Environmental tax										

income tax revenues, rents and fees for the use of natural resources, excise tax on goods imported into Ukraine, value added tax on goods imported into Ukraine and goods produced in Ukraine. Potentially, dissipation periods will last until December 2026–September 2028. For other taxes, fluctuations in negative and positive entropy production are not natural.

manifested in Ukraine are types T11, T12, T21, T32, and T33.

Accordingly, the study of entropy (Figure 2) and entropy production (Figure 3) was conducted for these types of taxes, the results of which confirmed the existence of specific features in the process of tax revenues’ formation.

A certain typology can be made based on the results obtained on the groups of taxes according to the laws of their dynamics and dissipative processes of revenue generation (Table 3). According to the conditional coding of tax types, the types

Type T11 is characterized by a gradual decrease in the level of entropy, which has the character of harmonic. Entropy production has fluctuated sharply with an exponential decline in 2019–2020. Since this type includes corporate income tax, val-

Table 3. Typology of taxes according to the peculiarities of the dynamics of tax revenues

By dissipative processes	By fractal-like dynamics		
	$h < 0.3; h > 0.7$	$0.45 > h > 0.3; 0.7 > h > 0.55$	$0.55 > h > 0.45$
Deep level of revenue dissipation, the tendency to increase the crisis	T11	T12	T13
	Corporate income tax, rent, rent for subsoil use, value added tax on goods produced in Ukraine	Excise tax on excisable goods imported into the customs territory of Ukraine, value added tax on goods imported into the territory of Ukraine	–
The average level of revenue dissipation, the tendency to reduce the crisis	T21	T22	T23
	Personal income tax, excise tax on excisable goods produced in Ukraine	–	–
Minor dissipation, crisis phenomena are either absent or unsystematic	T31	T32	T33
	–	Other taxes and fees, environmental tax, tax on the development of viticulture, horticulture and hop growing	Local taxes and fees, united tax

Source: Calculated by the authors.

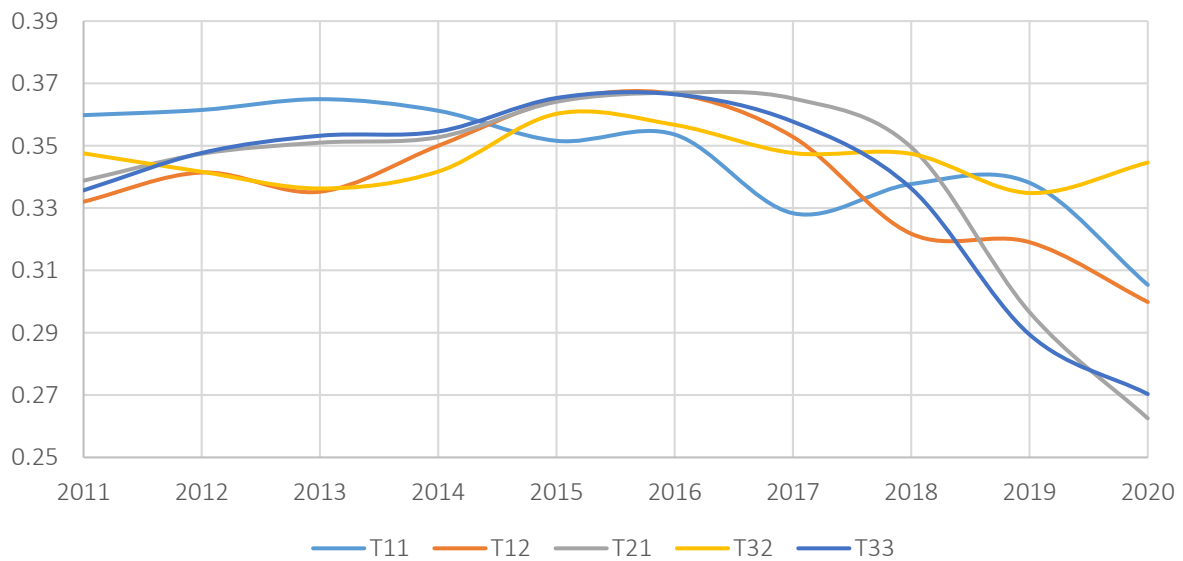


Figure 2. Dynamics of average annual entropy by types of taxes

ue added tax on goods produced in Ukraine, rent and rent for subsoil use, it can be argued that in real sector of the economy of Ukraine (and mainly in mining and heavy industry) crisis processes were particularly acute in the period 2019–2020.

Type T12 is characterized by an increase in entropy until 2019, respectively, negative entropy production occurs only in 2019–2020, but it is significant. Since the type includes excise taxes on excisable goods imported into the customs territory of Ukraine, value added tax on goods imported into Ukraine (consumption taxes), it is possible to link

the dissipation of revenues with a decrease in the purchasing power of the population.

Type T21 (personal income tax, excise tax on excisable goods produced in Ukraine) is also characterized by an increase in entropy by 2019 at the highest rate of all identified types and also a decrease in its level in 2019–2020. The distribution of revenues from personal income tax between the budgets of different levels, which in Ukraine has changed significantly during the period 2010–2017, may have an impact on the peculiarities of dynamics' trends. For example, in 2010, 23.6% of revenues in budgets of

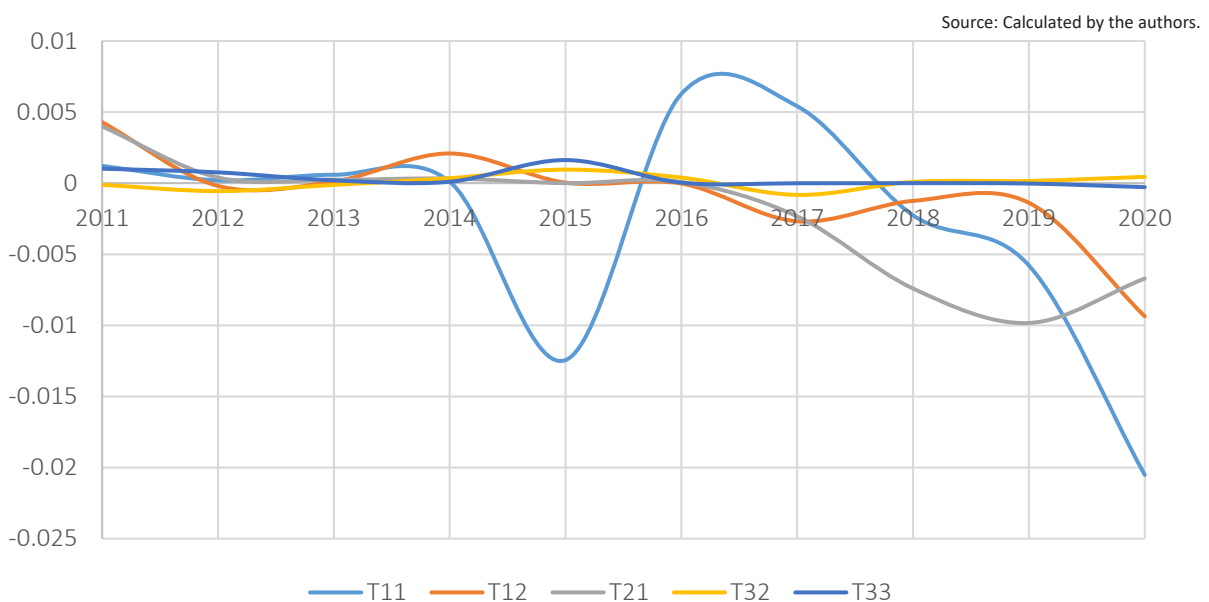


Figure 3. Dynamics of average annual entropy production by types of taxes

cities of national and regional significance were received from income taxes, and in 2016 – 34.3%, and in regional budgets – 18.3% and 24.9%, respectively (Tymchenko et al., 2018, p. 45). Entropy production for this group of taxes in the period 2010–2020 changes the trend – from downward to upward, which corresponds to the end of crisis processes. It can be argued that the main factor in the dissipation of tax revenues from these taxes is the effects of the Covid-19 pandemic and the corresponding decline in household incomes.

Type T32 (other taxes and fees, environmental tax, levy on the development of viticulture, horticulture and hop growing) has entropy dynamics, which is not characterized by any clear trend, entropy production also fluctuates at the level close to 0. This suggests the absence of clear dissipative processes. This group of taxes forms the most stable tax revenues, fractal-like dynamics can be determined by the peculiarities of tax collection.

Type T33 has an exponential downward dynamics of entropy, but the production of entropy is close to 0. The apparent contradiction between these patterns is due to the peculiarities of the form of probability density distribution for local taxes, fees and the single tax. If for other taxes the form of distribution has a right-handed asymmetry, then for these taxes the asymmetry of the distribution is left-handed and quite significant. Accordingly, the entropy for higher values of tax revenues is lower. However, it also means that for local taxes and the single tax dissipation with low negative entropy production can be high. Since tax revenues for this group of taxes are formed mainly by small businesses, a small dissipation may also mean a slight reduction in revenues with a significant reduction in the number of taxpayers. This is confirmed in the study of Glushchenko and Kozhalina (2019, p. 106), who note that the share of local taxes and fees in GDP for the period 2016–2018 decreased from 1.8% to 1.7% and in the revenues of the Consolidated budget decreased from 5.4% to 4.9%, the share in local budget revenues decreased from 11.6% to 10.4%.

4. DISCUSSION

The results of the study generally illustrate an aggravation of crisis processes in the economy of Ukraine

in the period 2011–2021. The negative production of entropy tax revenues occurs not in itself, but as a consequence of crisis (dissipative) processes in the national economy. The current economic crisis in Ukraine is long-lasting and comparable in duration to the Great Depression. From time to time certain signs of economic recovery in Ukraine (since 1991) are being replaced by new exacerbations of the crisis, often caused by exogenous shocks. The so-called “natural” period of depression for Ukraine was about to end, but it was the influence of external destructive factors that led to an increase in its duration. Such external destructive factors include, first of all, the military aggression, which increases the uncertainty of functioning of both public and private finances. The experience in applying certain instruments of public financial policy in countries that have been at war for a long time (Angola, the Republic of Congo, Croatia, Georgia, Indonesia, Liberia, Macedonia, Serbia, Solomon Islands, and Tajikistan), according to the study of Polchanov (2017), shows that the positive impact on the recovery of countries is caused by the limitation of redistribution of GDP through the budget by means of taxes, improving the tax mechanism and increasing government spending on capital expenditures. This also corresponds to the results of a study by Shkolnyk et al. (2021), which states that with increasing share of state revenues from taxes and fees for special use of natural resources, taxes on international trade, the structure of GDP may become less stable, which in the economic crisis will have negative consequences.

Maintaining approximately the same level of entropy for all tax groups until 2019 also illustrates that the current exacerbation of crisis is dominated by one factor, which was clearly manifested in the period 2019–2021. However, even at this time the deterioration of macroeconomic indicators for the Ukrainian economy was not as significant as predicted. According to different forecasts, Ukraine’s GDP in 2020 should have decreased by 3.5% (World Bank), 7.7% (IMF), 7% (according to the baseline scenario of the German Economic Team GET) (Savitska & Fuhelo, 2020, p. 190). The actual decline in GDP was 4% (State Statistics Service of Ukraine, n.d.). The IMF projected the growth of consumer prices by 4.5% in 2020 and by 7.2% in 2021. The actual consumer price inflation in 2020 was 2.7%.

Thus, the current period is one of those rare moments when the application of correctly chosen instruments of public financial policy can cause significant positive changes in the economy. This is especially true of public tax policy, which in the vast majority of countries is recognized as the most effective in regulating economic development.

It is proposed to differentiate the application of tax policy instruments according to the type of dynamics of tax revenues:

- for income tax, value added tax on goods produced in Ukraine, rent and rent for subsoil use, it is necessary to use instruments of stimulating tax policy, and the reduction of tax rates should be significant. Incentives can also be embodied in state transfers, state contracts, promotion of international procurement, etc. It will also be advisable to provide a wide range of tax benefits or tax holidays;
- for excise tax on excisable goods imported into the customs territory of Ukraine, value added tax on goods imported into Ukraine, the use of directly stimulating tax policy instruments is less appropriate. The reduction of dissipation in these revenues can be determined by ensuring the growth of effective demand and improving the tax mechanism;
- for personal income tax, excise tax on excisable goods produced in Ukraine the use of instruments of stimulating tax policy should be balanced and careful. The possible application of progressive tax rates is appropriate provided that they are small. An increase in excise tax rates is appropriate only for a limited group of luxury goods. An increase in household incomes through the development of the labor market will have a much greater stimulating effect. The reduction of dissipation for this group of taxes will be achieved in a derivative way if the instruments applied to the type of T11 are effective;
- for other taxes and fees, environmental tax, tax on the development of viticulture, horticulture and hop growing the use of any tools is not appropriate. The maintenance of zero entropy production will reduce the volatility

of revenues in the tax system as a whole and prevent the strengthening of its dissipation;

- it is doubtful to reduce the dissipation of tax revenues at the expense of local taxes and the single tax, for which there is now a slight negative entropy production. The positive impact on the revenues from local taxes and fees will lead to the improvement of the mechanism of their administration and introduction of new local taxes (Glushchenko & Kozhalina, 2019, p. 110).

However, it should be noted that an increase in revenues from these taxes will increase their volatility, as these taxes are essentially in the lump. An increase in the importance of lump-sum taxes, according to Seegert (2018, p. 3), negatively affects the volatility of revenues from them, as they concentrate risks in private consumption. This is also consistent with the results of this study. Given the chaotic nature of the dynamics of revenues from local taxes and the single tax, an increase in the volatility of these revenues will be a natural consequence of an increase in their fiscal significance.

Today the tax system reform and the transformation of tax policy in Ukraine are primarily aimed at changing the institutional framework for its implementation and improving the tax mechanism. High priority measures (Shemaeva et al., 2020, pp. 57-60) include improving the functionality of the tax system, development of electronic services and digitalization, counteraction to the hiding of profits from taxation, counteraction to the smuggling and “gray” imports, introduction of tax incentives for investment activity, promotion of social justice through tax regulation instruments. These areas are mostly not related to reducing the dissipation of the process of generating tax revenues. Among the instruments that will stop dissipation and promote economic growth are the introduction of a reduced VAT rate on necessities, progressive taxation of personal income, approximation of property taxes to the market value of land and real estate, simplification of procedures for expanding social tax relief and tax relief. However, the use of these instruments will mainly stimulate the development of consumption, affecting the real sector of the economy only in a derivative way. At the same time, it is the stimulation of the sphere of material produc-

tion that will lead to an increase in the corporate income tax and value added tax on goods produced in Ukraine (Martyntenko, 2019, pp. 32-33). It should be noted that according to some studies, economic growth does not lead to a significant increase in tax

revenues if a country is in a state of crisis (Eugene & Chineze, 2015). Therefore, a change in the vector of state tax policy, having long-term positive consequences, will have negative fiscal consequences in the early stages of its implementation.

CONCLUSION

Destructive processes in the crisis period cause violations of the usual patterns of macroeconomic processes. This also applies to the formation of tax revenues, the amount of which is not reliably predicted during the recession. Given the importance of tax revenues in ensuring the sustainability of social and economic development, the aim of the study was to determine the projected amount of tax revenues to the budget of Ukraine taking into account the patterns of their dynamics and the impact of the crisis.

The use of the chaos theory elements made it possible to identify the most characteristic features for the dynamics of tax revenues to the Consolidated Budget of Ukraine. To substantiate the possibility of obtaining reliable forecasts of their volume on the basis of parametric dependencies, simple or complex trend models, R|S-analysis was performed, the results of which confirmed that the dynamics of tax revenues to the budget is anti-persistent. The calculation of the Hirst indicator for different types of taxes, determined from monthly data for the period 2011–2021, characterized the dynamics of revenues for most of them as fractal-like and for local taxes and the single tax – as chaotic. To determine the amount of chaos in the dynamics of tax revenues, entropy and entropy production are calculated. Negative entropy production and accelerated dissipation of tax revenues during the crisis were stated. This became the basis for determining qualitative forecasts of the dynamics of tax revenues.

Taking into account the level of fractal-like nature and regularity of entropy production, a typology of taxes has been formed from nine potential types, of which five types of taxes have appeared in Ukraine. The regularities of entropy dynamics and entropy production for each of these types of taxes made it possible to draw a conclusion about the expediency of their active use in order for the Ukrainian economy overcome the crisis of tax instruments related to corporate income tax, value added tax on goods produced in Ukraine, rent and rent for subsoil use.

In summation, the dynamics of tax revenues during the crisis is anti-persistent, fractal-like and is characterized by negative entropy production in the period 2016–2020 for most types of taxes and potentially in 2021–2022.

AUTHOR CONTRIBUTIONS

Conceptualization: Oleh Skorba, Tetyana Pasko, Viktoriia Babenko-Levada, Tetiana Tereshchenko.

Data curation: Oleh Skorba, Tetyana Pasko.

Formal analysis: Oleh Skorba, Viktoriia Babenko-Levada, Tetiana Tereshchenko.

Funding acquisition: Oleh Skorba, Tetyana Pasko, Viktoriia Babenko-Levada, Tetiana Tereshchenko.

Investigation: Oleh Skorba.

Methodology: Tetyana Pasko, Viktoriia Babenko-Levada, Tetiana Tereshchenko.

Resources: Oleh Skorba.

Software: Oleh Skorba.

Validation: Oleh Skorba.

Visualization: Oleh Skorba.

Writing – original draft: Oleh Skorba.

Writing – review & editing: Oleh Skorba.

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